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B. T. GALLOWAY, Chief of Bureau.

MISCELLANEOUS PAPERS.

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Durango Cotton in the Imperial Valley . . . . . O. F. COOK
Improved Apparatus for Detecting Sulphured Grain . . . . . G. H. BASTON
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Keeping Soft Cuttings Alive for Long Periods . . . . . G. W. OLIVER

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[Cir. 111]

PRELIMINARY REPORT ON SUGAR PRODUCTION FROM MAIZE.[1]

By C. F. Clark, *Assistant Agronomist, Office of Cotton and Truck Disease and Sugar-Plant Investigations.*

INTRODUCTION.

The experiments described in the following pages were conducted under the direction of Mr. W. A. Orton, of the Bureau of Plant Industry, in cooperation with the Sugar Laboratory of the Bureau of Chemistry. The work was carried on during the summer of 1912 at Garden City, Kans., and Washington, D. C. At Garden City the field work was in charge of the writer and the analytical work under the direction of Mr. W. B. Clark, assisted by Messrs. R. J. Hamon and C. A. Hauser. At Washington the experimental plats, which were located on the Arlington Farm, were under the supervision of Mr. J. I. Milstead, of the Office of Horticultural Investigations, while the analytical work was performed under the direction of Mr. A. Hugh Bryan, of the Bureau of Chemistry. These preliminary studies have been carried out with only two varieties of corn. Other varieties might give more or less favorable results. It is well known that the maize plant responds to selection for specific purposes, and it is possible that results achieved in the selection of the beet to increase its sugar content might be paralleled with the proper selection of maize.

EXPERIMENTS AT GARDEN CITY.

The variety used was Stowell's Evergreen sweet corn. It was planted on May 15 and the ears were removed on August 9, when in the milk stage. For comparison alternate rows were left with the ears on. These stalks were analyzed at the same time as those from which the ears had been removed.

Analyses were made at frequent intervals extending from August 28 to September 25. The samples, which consisted of 10 stalks each, with the exception of the one analyzed September 7 which contained 30 stalks, were taken on the day in which the analyses were made. As soon as cut the stalks were taken to the laboratory and the juice extracted by running twice through a 3-roller mill. The solids were determined by the Brix spindle and the apparent sucrose by direct polarization, from which data the apparent purity was calculated. The results are given in Table I.

[1] Issued Feb. 1, 1913.

TABLE I.—*Composition of cornstalks grown and analyzed at Garden City, Kans.*[1]

Date of analysis.	Field treatment.	Solids.	Difference.	Sucrose, direct polarization.	Difference.	Apparent purity.	Difference.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Aug. 28	Ears removed	15.45	3.75	9.76	3.99	63.20	13.90
	Ears not removed	11.70		5.77		49.30	
Sept. 3	Ears removed	15.80	6.90	9.98	6.33	63.20	22.20
	Ears not removed	8.90		3.65		41.00	
Sept. 5	Ears removed	16.80	5.25	11.33	5.37	67.40	15.80
	Ears not removed	11.55		5.96		51.60	
Sept. 7	Ears removed	16.60	.....	10.85	.....	65.40	.....
Sept. 9	Ears removed	16.25	5.30	10.65	6.05	65.60	23.60
	Ears not removed	10.95		4.60		42.00	
Sept. 18	Ears removed	16.17	2.95	10.03	2.62	62.00	5.85
	Ears not removed	13.22		7.41		56.15	
Sept. 25	Ears removed	17.54	4.67	[2] 10.50	4.00	[2] 59.86	9.36
	Ears not removed	12.87		[2] 6.50		[2] 50.50	
	Average increase following removal of ears	.....	4.80	.....	4.73	.....	15.12

[1] Analyses made at the Garden City Field Laboratory of the Office of Sugar-Plant Investigations.
[2] These results are from Hauser's analyses; they seem to have been calculated from Clerget polarizations, in which case the values for sucrose and purity would be true instead of apparent, which would make both sets of figures higher, relatively, than those of the preceding analyses.

The data presented in Table I show that throughout the entire period covered by the analytical work there was a marked increase in the solids, in sucrose, and in purity as a result of removing the ears, the average increase in each case being 4.80, 4.73, and 15.12 per cent, respectively. In no instance was there a decrease. It will be seen that in the stalks from which the ears had been removed there was an increase in the percentage of sugar from the first analysis until September 5, when the maximum was reached. After this there was a small, though fairly uniform, decrease until September 25, when there was a slight increase.

EXPERIMENTS AT WASHINGTON.

FIELD DATA.

For the experiments at Washington, D. C., a dent corn was used, which was a selection of the Boone County White. It was planted about May 30 and the ears were removed on August 22. The following data were obtained regarding the weight of ears and the cost of removing the same:

Weight of ears from one-third acre ..... 2,754 pounds.
Time required to remove ears from one-third acre ..... 5 hours.
Time required to pick up ears and carry them from field ..... 3 hours.
Total cost of removal of ears from one-third acre (8 hours, at 15 cents) ..... $1.20.

ANALYTICAL METHODS AND RESULTS.

Analyses of the stalks from which the ears had been removed, as well as from those on which the ears remained, were made on Tuesday and Thursday of each week from August 27 to October 29. The

samples consisted of 24 stalks each and were taken the morning of the day the analyses were made. As soon as cut they were sent to the Bureau of Chemistry, where the juice was immediately extracted by running once through a 3-roller mill. The following analytical determinations were made of this juice: (1) Solids by Brix spindle, (2) direct and invert polarizations, (3) sucrose by Clerget, (4) invert sugar before reduction, and (5) percentage of moisture in the sample of cane as originally received. The purity of the juice—that is, the percentage of sucrose divided by the solids—was calculated from the data thus obtained. The results are presented in Table II, the summary of which shows the changes in composition of the juice following the removal of the ears.

TABLE II.—*Composition of cornstalks grown and analyzed at Washington, D. C.*[1]

EARS REMOVED.

Date.	Serial No.	Juice.					Cane.		
		Solids.	Sucrose.	Invert sugar.	Non-sugar solids.	Purity.	Water.	Sucrose.	Invert sugar.
1912.		*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*
Aug. 27	9728	12.78	7.58	2.88	2.32	59.3	.....	.....	.....
29	9736	12.46	6.94	2.90	2.62	55.7	.....	.....	.....
Sept. 3	9740	14.11	8.58	3.00	2.53	60.8	73.94	7.38	2.58
5	9758	14.50	9.11	2.24	3.15	62.8	74.56	7.94	1.95
10	9769	15.32	9.54	2.33	3.55	62.3	71.86	8.09	1.98
12	9773	16.81	11.27	1.98	3.56	67.0	73.91	10.01	1.76
17	9791	16.25	10.70	1.74	3.81	65.9	70.58	9.02	1.46
19	9800	15.64	10.18	1.69	3.77	65.1	74.64	9.01	1.49
24	9817	14.68	9.42	1.51	3.75	64.2	66.40	7.33	1.17
26	9823	9.50	4.86	1.67	1.97	51.1	75.97	4.08	1.40
Oct. 1	9837	15.07	9.42	1.85	3.80	62.5	70.79	7.85	1.54
3	9840	15.30	9.72	1.84	3.74	63.5	70.54	8.09	1.53
8	9854	15.50	10.02	1.70	3.78	64.6	69.88	8.28	1.40
10	9871	15.52	10.10	1.76	3.66	65.1	72.74	8.70	1.51
15	9939	11.22	6.40	1.62	3.20	57.0	78.70	5.67	1.43
17	9956	10.45	5.56	1.92	2.97	52.2	71.03	4.40	1.52
22	10005	15.83	9.46	2.26	3.11	59.8	69.35	7.80	1.86
24	10025	13.87	7.61	2.55	3.71	54.9	67.36	5.95	1.99
29	10072	15.22	9.01	2.38	3.83	59.2	67.01	7.12	1.88
Average	.....	14.21	8.71	2.09	3.31	60.68	71.73	7.45	1.67

EARS NOT REMOVED.

Aug. 27	9729	10.08	4.08	3.49	2.51	24.7	.....	.....	.....
29	9737	8.41	3.13	2.76	2.52	37.2	.....	.....	.....
Sept. 3	9741	7.50	2.64	2.51	2.35	35.2	80.35	2.29	2.18
5	9759	8.70	3.53	2.92	2.25	40.7	79.30	3.06	2.53
10	9770	6.45	1.81	1.96	2.68	29.6	82.94	1.60	1.73
12	9774	6.30	1.88	1.80	2.62	30.0	80.42	1.61	1.54
17	9792	8.38	3.39	2.32	2.67	40.3	75.86	2.80	1.92
19	9801	6.99	2.53	1.80	2.66	36.2	82.56	2.24	1.59
24	9818	7.48	2.53	1.83	3.12	33.9	72.46	1.98	1.43
26	9824	5.97	1.63	1.61	2.73	27.3	80.60	1.39	1.38
Oct. 1	9838	6.09	1.55	1.42	3.12	25.4	81.42	1.34	1.23
3	9841	6.87	2.34	1.54	2.99	34.0	81.94	2.06	1.35
8	9855	9.03	4.24	1.93	2.86	46.9	76.90	3.58	1.63
10	9872	8.95	4.24	1.91	2.80	47.4	76.52	3.56	1.60
15	9940	8.07	3.18	1.92	2.97	39.4	77.10	2.66	1.61
17	9957	10.08	5.18	2.35	2.55	51.3	77.66	4.47	2.03
22	10006	10.21	6.86	1.96	1.39	67.1	69.75	5.32	1.52
24	10026	9.65	4.45	1.96	3.24	46.1	76.41	3.76	1.66
29	10073	9.35	3.73	2.57	3.05	39.8	73.52	3.03	2.08
Average	.....	8.13	3.31	2.13	2.69	38.55	77.98	2.75	1.71

[1] Analyses made by Sugar Laboratory, Bureau of Chemistry.

TABLE II.—*Composition of cornstalks grown and analyzed at Washington, D. C.*—Con.

SUMMARY SHOWING CHANGES IN COMPOSITION OF JUICE FOLLOWING REMOVAL OF EARS.

Date of analysis.	Field treatment.	Solids.	Difference.	Sucrose.	Difference.	Invert sugar.	Difference.	Nonsugar solids.	Difference.	Purity.	Difference.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Aug. 27	Ears removed	12.78	2.70	7.58	3.50	2.88	−.61	2.32	−.19	59.3	34.6
	Ears not removed.	10.08		4.08		3.49		2.51		24.7	
29	Ears removed	12.46	4.05	6.94	3.81	2.90	.14	2.62	.10	55.7	18.5
	Ears not removed.	8.41		3.13		2.76		2.52		37.2	
Sept. 3	Ears removed	14.11	6.61	8.58	5.94	3.00	.49	2.53	.18	60.8	25.6
	Ears not removed.	7.50		2.64		2.51		2.35		35.2	
5	Ears removed	14.50	5.80	9.11	5.58	2.24	−.68	3.15	.90	62.8	22.1
	Ears not removed.	8.70		3.53		2.92		2.25		40.7	
10	Ears removed	15.32	8.87	9.54	7.73	2.33	.37	3.55	.87	62.3	32.7
	Ears not removed.	6.45		1.81		1.96		2.68		29.6	
12	Ears removed	16.81	10.51	11.27	9.39	1.98	.18	3.56	.94	67.0	37.0
	Ears not removed.	6.30		1.88		1.80		2.62		30.0	
17	Ears removed	16.25	7.87	10.70	7.31	1.74	−.58	3.81	1.14	65.9	25.6
	Ears not removed.	8.38		3.39		2.32		2.67		40.3	
19	Ears removed	15.64	8.65	10.18	7.65	1.69	−.11	3.77	1.11	65.1	28.9
	Ears not removed.	6.99		2.53		1.80		2.66		36.2	
24	Ears removed	14.68	7.20	9.42	6.89	1.51	−.32	3.75	.63	64.2	30.3
	Ears not removed.	7.48		2.53		1.83		3.12		33.9	
26	Ears removed	9.50	3.53	4.86	3.23	1.67	.06	1.97	−.76	51.1	23.8
	Ears not removed.	5.97		1.63		1.61		2.73		27.3	
Oct. 1	Ears removed	15.07	8.98	9.42	7.87	1.85	.43	3.80	.68	62.5	37.1
	Ears not removed.	6.09		1.55		1.42		3.12		25.4	
3	Ears removed	15.30	8.43	9.72	7.38	1.84	.30	3.74	.75	63.5	29.5
	Ears not removed.	6.87		2.34		1.54		2.99		34.0	
8	Ears removed	15.50	6.47	10.02	5.78	1.70	−.23	3.78	.92	64.6	17.7
	Ears not removed.	9.03		4.24		1.93		2.86		46.9	
10	Ears removed	15.52	6.57	10.10	5.86	1.76	−.15	3.66	.86	65.1	17.7
	Ears not removed.	8.95		4.24		1.91		2.80		47.4	
15	Ears removed	11.22	3.15	6.40	3.22	1.62	−.30	3.20	.23	57.0	17.6
	Ears not removed.	8.07		3.18		1.92		2.97		39.4	
17	Ears removed	10.45	.37	5.56	.38	1.92	−.43	2.97	.42	52.2	.9
	Ears not removed.	10.08		5.18		2.35		2.55		51.3	
22	Ears removed	15.82	5.62	9.46	2.60	2.26	.30	3.11	1.72	59.8	−7.3
	Ears not removed.	10.21		6.86		1.96		1.39		67.1	
24	Ears removed	13.87	4.22	7.61	3.16	2.55	.59	3.71	.47	54.9	8.8
	Ears not removed.	9.65		4.45		1.96		3.24		46.1	
29	Ears removed	15.22	5.87	9.01	5.28	2.38	−.19	3.83	.78	59.2	19.4
	Ears not removed.	9.35		3.73		2.57		3.05		39.8	
	Average increase or decrease (−) following removal of ears	.....	6.08	.....	5.40	.....	−.04	.....	.62	.....	22.13

The summary of Table II shows that very marked changes were produced in the composition of the juice as a result of the removal of the ears. Each analysis showed an increase in solids, in sucrose, in nonsugar solids (with two exceptions), and in purity (with one exception). Of the 19 determinations for invert sugar 9 showed an increase and 10 a decrease, the average of which (−0.04 per cent) is so small as to be considered negligible.

If we compare the averages of all determinations which are brought together in the table, it will be seen that the greatest effect resulting from the removal of the ears is on the sucrose content. While there was a substantial gain in nonsugar solids, the increase was not nearly so great as in the case of the sucrose. The percentage of invert sugar, as has already been pointed out, was scarcely affected.

The sugar content where the ears had been removed (Table II) increased at a very uniform rate from the date of the first analysis until September 12, when the maximum was reached. After this there was a decrease, which, however, was subject to considerable fluctuation. It will be noted that the last sucrose determination (9.01 per cent) is somewhat higher than the average for the entire season (8.71 per cent).

The percentage of invert sugar was highest during the early part of the season, after which there was a decrease, followed by an increase toward the end of the season.

That the accumulation of sugar is affected very quickly by the removal of the ears is indicated by the fact that the analysis of August 27, which was only five days after the ears were removed, showed an increase in sugar content of 3.5 per cent.

PRESSING, CLARIFICATION, AND EVAPORATION.

The experiments included under this heading were conducted by Mr. Bryan, who reports as follows:

EFFECT OF SEPARATE PRESSINGS.

In order to study the effect of extra pressing, a sample of cornstalks was run through the mill and the juice collected. The stalks were again run through the mill and this juice collected. The pressed cane coming from this second pressing was moistened with water and then run through the mill. This juice was collected. The juice coming from the three pressings was analyzed separately; then all mixed together and the mixed juice analyzed. The results of this work are shown in Table III.

TABLE III.—*Composition of juice from separate pressings.*

Juices analyzed.	Solids.	Sucrose.	Invert sugar.	Ash.	Nonsugar solids.	Purity.
	Percent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Percent.*
Juice from first pressing	14.76	10.02	1.82	0.66	2.26	67.9
Juice from second pressing	15.36	10.17	1.63	.68	2.88	66.2
Juice from maceration	9.81	6.56	.93	.45	1.87	66.9
Mixed juice	13.41	8.97	1.56	.58	2.30	66.8

It will be noted that the juice from the second pressing contains slightly more solids and also sucrose than the juice of the first pressing. At the same time it is much higher in nonsugar solids, which gives it a lower purity. This fact is always noted in cane-sugar manufacture, viz, that the purer juice comes from the first pressing and as pressing increases the juice becomes more impure.

CLARIFICATION AND EVAPORATION.

To the mixed juice, milk of lime was added to a slight alkalinity, as shown by litmus paper. The lime used contained about 40 per cent magnesium. The whole was then heated nearly to boiling or to a point where the scum easily separated from the clear juice. The heat was then turned off and the juice allowed to settle. The clear juice was then filtered off, brought to a boil, and skimmed.

In order to test the effect of concentration in acid solution, water saturated with sulphur dioxid was then added to the boiling juice until it was decidedly acid to litmus paper. The whole was then evaporated to a sirupy consistency. The analysis of the juice after sulphuring but before evaporation showed the following composition:

TABLE IV.—*Analysis of juice after sulphuring.*

Juice.	Solids.	Sucrose.	Invert sugar.	Ash.	Nonsugar solids.	Purity.
	Percent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Percent.*
After sulphuring but before evaporation	14.96	10.10	1.79	0.71	2.36	67.5

By the use of lime and sulphur dioxid it is seen that there had been a rise in purity, which indicates a clarification by removal of some of the organic material. When this concentrated material had reached a proper density, as told by appearances, it was allowed to cool slowly. Crystals of sucrose did not appear immediately, but after a week well-defined crystals of sucrose were noted. These continued to grow.

COMPARISON OF CORN WITH SORGHUM AND SUGAR CANE.

In order to show the relative value of corn as a source of sugar in comparison with other sugar-producing plants belonging to the grass family, Table V has been prepared.

TABLE V.—*Comparison of corn with sorghum and sugar cane as a source of sugar.*

Plant source.	Solids.	Sucrose.	Invert sugar.	Nonsugar solids.	Purity.
Corn:					
Grown at Garden City, Kans.—	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ears removed	16.37	10.44	.....	.....	63.81
Ears not removed	11.53	5.65	.....	.....	48.43
Grown at Washington, D. C.—					
Ears removed	14.21	8.71	2.09	3.31	60.68
Ears not removed	8.13	3.31	2.13	2.69	38.55
Sorghum [1]	14.11	9.11	.82	4.18	64.48
Sugar cane:					
Louisiana [2]	15.30	12.15	1.35	1.78	79.19
Hawaii [3]	17.86	15.59	.43	1.84	87.28

[1] Average of analyses of 20-stalk samples of four varieties (Early Amber, Coleman, Orange, and McLean) grown at Garden City, Kans., in 1912 in the same field as the corn.

[2] Average of analyses of D. 74, D. 95 and home canes for nine years, 1895 to 1903. See Stubbs, W. C., and Blouin, R. E., Comparative results of seedling sugar canes, D. 74 and D. 95, with our home sugar canes (Louisiana Striped and Louisiana Purple), Louisiana Agricultural Experiment Station Bulletin, s. 2, no. 78, p. 7–11, [1904].

[3] Average of analyses of 17 varieties of plant cane harvested in 1904 and ratoon crop from the same planting harvested in 1906. See Eckart, C. F., Comparative tests with varieties of sugar cane, Hawaiian Sugar Planters' Association, Division of Agriculture and Chemistry, Bulletin 17, p. 6.

The corn grown at Garden City from which the ears had been removed was higher in solids than either sorghum or Louisiana

sugar cane, but lower than Hawaiian cane. The corn grown at Washington was slightly higher than the sorghum in solids, but lower than either Louisiana or Hawaiian sugar cane. At Garden City the sucrose content was higher in the corn than in sorghum, while at Washington the opposite condition was found. In both instances it was lower than in sugar cane. The percentage of invert sugar was higher in corn than in either of the other plants. The nonsugar solids were lower in corn than in sorghum, but higher than in sugar cane. The purity was lower in corn from both localities than in sorghum or sugar cane.

SUMMARY.

The results of the present season's work show that by the removal of the immature ears from cornstalks the sucrose content of the juice is greatly increased. There is also a small increase in nonsugar solids and a very pronounced increase in purity. The percentage of invert sugar is not materially affected.

The purity coefficients of the juices are relatively low, the highest being 67.4 per cent.

As a sugar-producing plant corn compares very favorably with sorghum in the chemical composition of its juice, but it is much lower than sugar cane in sucrose and purity.

DURANGO COTTON IN THE IMPERIAL VALLEY.[1]

By O. F. Cook, *Bionomist in Charge of Crop Acclimatization and Adaptation Investigations.*

INTRODUCTION.

Durango cotton is a new type of long-staple Upland cotton recently introduced and acclimatized by the United States Department of Agriculture. The behavior of the Durango cotton in numerous experimental and field plantings leaves no doubt that the variety is well suited to the irrigated lands of the Imperial Valley of southern California. Other long-staple varieties have given excellent results when the conditions happened to be favorable, but the Durango has shown a wider range of adaptation and has produced good crops in places where other long-staple cottons were comparative failures. The success of the new variety has aroused popular interest and is stimulating the development of a long-staple cotton industry in southern California.

There is every reason to expect that long-staple cotton will become one of the chief products of irrigation farming in the Southwest. In addition to very favorable natural conditions and the absence of boll weevils, the cotton growers of the irrigated districts are more ready to avail themselves of the many advantages that are to be secured through the organization of local cotton-growing associations for the production of a single superior type of cotton in the community.[2]

DEVELOPMENT OF DURANGO COTTON.

Durango cotton is one of several varieties developed by the Department of Agriculture with a view to mitigating the injuries of the boll weevil in Texas and adjacent States. The probability that the weevil would seriously interfere with the cultivation of the late-maturing types of long-staple Upland cotton formerly grown in the Red River Valley and in the Yazoo Delta region of Mississippi and Louisiana was foreseen several years before the long-staple districts

[1] Issued Feb. 1, 1913.

[2] These advantages have been considered in detail in an article published in the Yearbook of the Department of Agriculture for 1911 under the title "Cotton improvement on a community basis." Separate reprints of this article can be obtained by application to the Superintendent of Documents, Government Printing Office, Washington. D. C., upon the payment of a fee of 5 cents each.

were actually invaded by the weevils. It was feared that the weevil invasion might result in the complete destruction of the long-staple industry unless earlier and more prolific varieties could be developed.

The Columbia, Foster, and Durango varieties may serve to illustrate three different methods that were employed by the Department of Agriculture in the effort to develop earlier long-staple sorts. The Columbia cotton was obtained by straight selection from a short-staple variety, the Foster by crossing long and short staple varieties, and the Durango by acclimatization and selection of an imported stock.

Several other promising types of Upland cotton have been secured by the Department of Agriculture from weevil-infested regions in Mexico and Central America and acclimatized in the United States on account of special characters or habits that render them less susceptible to weevil injury. The Durango is the first of these to attain sufficient uniformity to justify general distribution. The fact that the Durango cotton has weevil-resisting characters is not important, of course, in the Imperial Valley, where there are no boll weevils; but the variety has other good qualities, quite apart from weevil resistance.

That valuable new varieties should be found in Mexico and other parts of tropical America should not appear surprising in view of the fact that most of the types of cotton now cultivated in the United States appear to have been introduced from tropical America. The so-called Texas big-boll varieties are supposed to have been derived from a Mexican stock introduced only a few decades ago. The introduction of the Sea Island cotton from the West Indies is also a matter of history.

The acclimatization of Durango cotton was begun seven years ago, in 1905, when the original stock of seed from the State of Durango, Mexico, was planted for the first time in Texas. The superior type represented by the present select strain was first recognized and isolated at Del Rio, Tex., in October, 1907. The introduction of the variety into the Imperial Valley occurred in 1911, when a field of about 3 acres was grown on the farm of Mr. W. E. Wilsie, near El Centro. About 200 acres were planted in 1912 in the vicinity of El Centro and Holtville. Recent advices state that a carload of the Durango cotton has been sold at El Centro at 17½ cents per pound, which is equivalent to about 19 cents in eastern markets.

CULTURAL CHARACTERS OF DURANGO COTTON.

Durango cotton is valuable because it represents an unusual combination of desirable cultural characters with length and high quality of staple. From the agricultural point of view all of the well-known

long-staple Upland varieties have appeared at a serious disadvantage in comparison with the short-staple varieties in being later and less productive and more difficult to pick because of the smaller size of the bolls. But Durango cotton is as early, as prolific, and as easy to pick as most of the short-staple varieties that are now being grown in the cotton belt. In the Imperial Valley the Durango cotton has outyielded the short-staple varieties, in addition to producing a much more valuable fiber.

The only varieties of short-staple cotton that can be said to compete with the Durango cotton in the Southwest belong to the Texas big-boll type, such as the Rowden, Triumph, and Lone Star. These varieties have larger bolls than the Durango cotton, but are distinctly inferior in habits of growth. When the conditions favor a luxuriant development of the plants, as they usually do in the Imperial Valley, the Texas big-boll varieties appear at a special disadvantage on account of the weaker stalks and heavier foliage.

The Triumph cotton, which has been the principal short-staple variety in the Imperial Valley, often becomes entirely prostrate before the picking season arrives, or hides the bolls under a dense mass of foliage. It is often necessary to hold up the plants with one hand in order to pick the cotton with the other. The heavy shade also tends to keep the bolls moist, and many of them are rotted or mildewed. The Durango variety has stronger stalks. The plants maintain a more erect position, with the bolls much more readily accessible to the picker. (Fig. 1.)

The lighter and more open foliage renders the Durango cotton less susceptible to rotting of the bolls or to discoloration of the fiber by contact with the soil or by molding under heavy shade. The contrast in foliage characters and habits of growth between the Durango and Triumph is so striking that some of the Imperial Valley growers were able to pick the two varieties separately in fields that had been planted with mixed seed. Even the most unskillful picker could see the difference between the small, low, or prostrate Triumph, densely covered with large leaves, and the large, upright Durango plants, with their more open foliage and larger crops of bolls.

DURANGO COTTON COMPARED WITH THE COLUMBIA.

Several varieties of Upland long-staple cotton have been tested in the Imperial Valley in experimental plantings, so as to permit close comparisons to be made between adjacent rows of the different sorts. In this way it is possible to secure a much clearer idea of differences of behavior than can be gained from plantings in separate fields.

Under the Imperial Valley conditions Durango cotton has shown marked superiority over the Columbia both in yield and in quality of fiber. In 1911, 4 bales of Durango cotton were grown on less than

3 acres, while an equal area of Columbia produced less than 1 bale. In 1912 both fields were planted to Durango cotton, which produced an excellent crop on the same land where the Columbia had failed the year before. The behavior of the Columbia in a near-by experimental planting was much the same in 1912 as in 1911. Even where the plants had ample exposure instead of field conditions the yield was altogether inferior to that of adjacent plants of the Durango cotton. (Fig. 2.)

FIG. 1.—Durango cotton plant at El Centro, Cal., with leaves removed to show habits of branching.

Comparisons between some of the best plants in the two rows showed over three times as many open bolls on the Durango plants and a general yield of about twice that of the Columbia. These contrasts appeared the more remarkable because the Columbia is a very prolific variety in the South Atlantic States.

The differences of behavior can be understood when the habits of the two varieties are compared in detail. The failure of the Columbia cotton to develop a large crop of bolls under the Imperial Valley conditions is evidently connected with the tendency to produce a dense canopy of leaves. This is quite different from the behavior of the

variety in the Atlantic States, where the plants are smaller and more prolific and have much more open foliage.

When the foliage becomes too dense only the growing ends of the stalks and vegetative branches have adequate exposure to the sunlight, while the fruiting branches are heavily shaded. Many of the buds are blasted and many of the bolls fail to reach normal maturity. Premature opening of the bolls and mildewing under the continuous shade also contribute to the inferiority of the fiber. There are also many plants with short lint, showing that degenerate variations have

FIG. 2.—Columbia cotton plant (left) and Durango cotton plant (right), showing different habits of growth, at El Centro, Cal. The Columbia plant had 22 open bolls, the Durango plant 62.

been induced by the new conditions. Such degeneracy was especially noticeable among volunteer plants of the Columbia variety in the season of 1912.

If the tendency to luxuriant growth and heavy foliage could be restrained by withholding water or planting on less fertile soils, somewhat more favorable results could doubtless be secured with Columbia cotton. But the Durango is much better adapted to the general conditions in the Imperial Valley, and there is no reason for making special efforts to grow the Columbia. The fact that the

Columbia variety is not well adapted to southwestern conditions does not affect its value in South Carolina and adjacent States, where it is now attaining a well-merited popularity.

DURANGO COTTON COMPARED WITH THE FOSTER.

The Foster is a variety of long-staple Upland cotton bred by Dr. D. A. Saunders, of this department. It was developed from a hybrid between the Triumph variety of Texas big-boll cotton and Sunflower, a well-known long-staple Upland variety of the Peeler type. Foster cotton is adapted to the Red River Valley of Louisiana and northeastern Texas, where it originated. It is an early, prolific variety, producing $1\frac{1}{4}$-inch lint under favorable conditions, but shows a persistent tendency to occasional reversions toward the characters of the Triumph parent. It is on account of this tendency to variation that the Foster cotton has not been distributed more widely in the long-staple districts of Louisiana and Mississippi, though excellent results have been secured with many plantings.

The behavior of Foster cotton in the Imperial Valley does not present the same difficulties as in the case of Columbia. The plants do not become very luxuriant or densely leafy, but show rather an opposite tendency to early maturity and dwarfing, which limit the yield. Thus, in an experimental-row planting at El Centro in 1912 even the largest of the Foster plants were scarcely half the size of the Columbia and Allen that stood on either side of the Foster row. (Fig. 3.) Some of the Foster plants were very prolific for their size, but the best of them produced less than a third as many bolls as the Durango. The yield was only a little more than half that of the Columbia or a quarter that of the Durango. (Fig. 4.)

A few fields of Foster cotton were grown in the Imperial Valley in 1912 from seed secured from Mississippi under the name "Unknown." The seed seems to have been brought to the valley under the impression that it represented the regular long-staple or Peeler cotton, in order to test the possibilities of this type of cotton in the Imperial Valley. But in reality the behavior of the Foster cotton is radically different from that of a true Peeler cotton, such as the Allen, which stood next to the Foster in the experimental plantings made by the Department of Agriculture. In the fields of Foster, or so-called "Unknown," diversity was very apparent in the habits of growth of the plants and the sizes and shapes of the leaves and bolls. Lint samples showed the usual tendency to Triumphlike reversions, rendering the staple distinctly less uniform than in the Durango, though still of good, marketable quality. The yield also did not approach that of many of the Durango fields.

DURANGO COTTON COMPARED WITH THE ALLEN.

The Allen variety has been included in experimental plantings as the best representative of the Peeler varieties which formerly furnished the long-staple crop of Mississippi and Louisiana. The results leave no doubt that in the Imperial Valley the Allen is a very unpromising variety, on account of the usually low yields of seed cotton, the low percentage of lint, and the small bolls. Even when the plants are large and vigorous they may yield very little (fig. 3). In all these particulars the Allen falls far below any of the other varieties included in the test. In the El Centro planting of 1912 the lint

FIG. 3.—Allen cotton plant (left) and Foster plant (right), showing different habits of growth at El Centro, Cal. The Allen plant had 12 open bolls, the Foster plant 14, in rows adjacent to those illustrated in figure 2.

percentage was only 20, whereas none of the other varieties fell below 27 and the Durango gave over 30. With respect to the size of the bolls the Allen cotton has little or no advantage over the Egyptian varieties and is also less productive. If the Peeler cottons were the only Upland long-staple type available there would be no prospect of establishing a long-staple industry in the Imperial Valley, for planters would continue with short-staple cottons or go over to the Egyptian. Either of these alternatives would be more promising than the growing of the Peeler varieties.

DURANGO COTTON COMPARED WITH THE EGYPTIAN.

On account of the present scarcity of Upland long-staple cotton the Durango cotton enjoys a somewhat artificial and perhaps temporary market advantage over the Egyptian. The scarcity of long-staple Upland cotton is due largely to the fact that the presence of the boll weevil interferes with the growing of the Peeler varieties in the former centers of production in Mississippi and Louisiana. Short-staple varieties have replaced the long staples in many districts, but efforts are now being made to go back to the cultivation of long staples on the basis of the new early varieties like the Columbia, Foster, and Durango. A part of the deficiency is being made good by the planting of Columbia and other early long-staple varieties in the Piedmont region of the South Atlantic States, but it may be several years before an adequate supply of long staples can be developed in this region.

FIG. 4.—Boll of Durango cotton, with involucre, showing relatively small bracts. (Natural size.)

Although the relative desirability of the Durango or of Egyptian cotton for the Imperial Valley and other irrigated regions of the Southwest is likely to fluctuate with the state of the market, it will be very poor policy for cotton-growing communities to make frequent changes from one type of cotton to the other. To learn the methods of growing, selecting, handling, and marketing either type to the best advantage is likely to require several years, so that a change from one to the other must be a very expensive operation. Scarcity of labor and the higher cost of picking are local factors that now stand seriously in the way of developing community production of the Egyptian cotton in the Imperial Valley and make it appear preferable to adopt the Durango. Even though the individual farmer may not agree with his neighbors regarding the variety or type of cotton that should be grown, he is likely to gain more by growing the community variety than by producing a small quantity of some other kind of cotton that he is unable to sell to advantage.

SPECIAL CHARACTERS OF DURANGO COTTON.

In addition to the features to which reference has been made in the preceding paragraphs, several other characteristics of Durango cotton are worthy of mention.

One of the most peculiar characters is shown in the seedlings. In most other kinds of cotton the seedlings produce at least two or three simple oval leaves before beginning to develop leaves of the usual lobed form of the adult plant. But in Durango cotton a large proportion of the seedlings have lobes on all the leaves, including the first leaf above the seed leaves. This character might be of use in determining early in the season whether any planting of Durango cotton is pure. The only other variety that has been found to have any considerable proportion of the first leaves lobed is the Allen.

In Durango cotton the tendency to produce vegetative branches is less than in most other varieties, and it can be reduced still further by leaving the plants close together in the rows. Earlier crops and larger yields have been obtained in this way than by the usual method of thinning the plants early to 2 feet or upward. Some of the best yields have been obtained from plants only 6 or 8 inches apart in the rows.

Another peculiarity of Durango cotton is the unusually small size of the involucral bracts. The difference in this respect between the Durango and the Triumph or other Texas big-boll varieties is very striking. The smaller bracts of the Durango cotton are a distinct advantage from the standpoint of clean picking, for the ends of the dry bracts are not so likely to be broken off and gathered with the fiber (fig. 4). Fragments of the involucral bracts furnish a large part of the "trash" that goes to the gin with the cotton and lowers the grade of the bale.

The following formal description of the Durango variety has been supplied in connection with the congressional seed distribution:

Plant of upright habit with a strong central stalk and rather stiff ascending vegetative branches. Fruiting branches of moderate length or rather short, under some conditions becoming semicluster. Foliage rather deep green, reddening early in the season. Leaves of medium size, usually with five or seven rather narrow tapering lobes, leaves with three lobes being less frequent than in most other varieties of upland cotton. Involucral bracts with rather small, triangular cordate bracts, margined with rather short teeth. Calyx lobes irregular in length, sometimes very long and slender. Bolls of medium or rather large size; under favorable conditions about 60 to the pound. Shape of bolls conic oval with nearly smooth surface, the oil glands deeply buried. (Fig. 5.) The proportion of five-locked bolls varies usually from 40 to 50 per cent. Seeds of medium size, covered with white fuzz and uniform abundant lint about 1¼ inches long under favorable conditions.

THE PURE-SEED PROBLEM.

As uniformity is a prime requisite with long-staple cotton, it is idle to expect that a prosperous long-staple industry can be built up in the Imperial Valley or elsewhere unless provision is made for maintaining the purity of the variety on which the industry is based. With short-staple cotton uniformity in the plants is important as a

means of securing high yields, though the question of uniformity of fiber is seldom raised in the short-staple market. But uniformity is an important factor in the market value of long-staple cotton. Loss of uniformity is one of the chief causes for the failure of many attempts to introduce long-staple varieties into short-staple districts of the Southern States. The usual inference in such cases is that the conditions are unfavorable for the long-staple varieties, whereas the injury has come usually through admixture of short-staple seed and neglect of selection. This will soon destroy the uniformity and commercial value of any long-staple variety, no matter how well bred at the beginning.

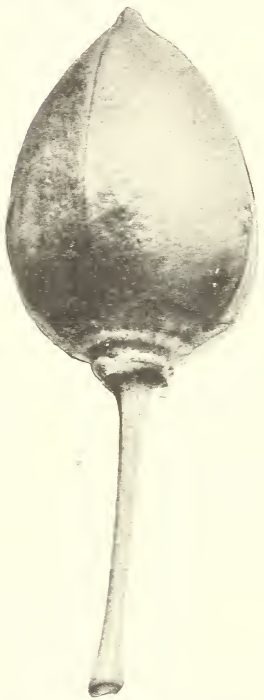

FIG. 5.—Boll of Durango cotton, showing typical form. (Natural size.)

EDUCATION OF COTTON BREEDERS.

Selection is not difficult for those who have sufficient familiarity with the characteristics of a variety, but most farmers are not accustomed to doing work of this kind and prefer to buy their seed instead of growing it for themselves. Nevertheless, each community should have enough local breeders or seed growers to maintain the necessary supply of select seed. The work of selection has been rendered easier and more effective by the development of improved methods, as described in other publications of the Bureau of Plant Industry.[1]

A certain amount of practice in observation is required to develop skill in recognizing differences between individual plants, so as to preserve those that are true to type and reject all that are abnormal or aberrant. Ability to do this is not rare, though seldom developed or applied. The problem of educating more cotton breeders is now receiving attention, and it is hoped that opportunities of learning this art may be provided in the Imperial Valley in the coming season.

ERADICATION OF WEED COTTON.

An unusual difficulty arises from the fact that in the Imperial Valley cotton so frequently survives the winter in the fields or escapes in waste places, wherever the seed happens to be scattered. Though

[1] Local adjustment of cotton varieties. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 159, and Cotton selection on the farm by the characters of the stalks, leaves, and bolls. U. S. Department of Agriculture, Bureau of Plant Industry, Circular 66.

the plants are usually killed to the ground in the fall, the roots remain alive and send up new shoots in the spring from subterranean buds. If a determined effort is to be made to place the growing of cotton in the Imperial Valley on a Durango basis one of the first steps should be to eradicate all the plants of other varieties from the fields as well as those that are now scattered about like weeds in many neighborhoods. An escaped cotton plant is much more dangerous than any ordinary weed. The contamination of a select variety is not a merely temporary injury, but may take years of careful selection to eliminate.

In view of the obvious danger of contamination from the overwintered plants or from volunteers that spring up from scattered seed of the previous season, it is certainly inadvisable to plant Durango cotton on any land where cotton was grown the year before. Neglect of this precaution and that of separate ginning of the seed planted in the season of 1912 has resulted in a contamination of nearly all of the Durango seed in the Imperial Valley, which is now recognized as a serious loss to the community. The present stock of seed will need to be discarded and replaced by new supplies of select seed that are being brought in from Texas. But any pure stock will soon become contaminated if other kinds of cotton are allowed to grow in adjacent fields or along borders or ditch banks, where volunteer plants are often found.

CONCLUSIONS.

The Durango cotton is a new type introduced and acclimatized by the Department of Agriculture and recommended in 1911 as the Upland long-staple variety best suited to irrigated conditions in the Southwestern States. Further experimental and field plantings in 1912 have rendered the superiority of the new type still more apparent.

Excellent results have been secured in numerous plantings of the Durango variety in the Imperial Valley in 1912. The superiority of the new type has become still more apparent and is recognized by the local cotton-growing community, which is now making an organized effort to place the valley exclusively on a Durango basis.

The superiority of the Durango variety lies in the fact that it combines the desirable cultural qualities of short-staple varieties with length and strength of lint formerly obtained only from the so-called Peeler varieties of the Delta region of Mississippi and Louisiana. All the experiments indicate that the Durango cotton is much better adapted to the Imperial Valley conditions than any other long-staple Upland variety.

The idea of transferring the Delta varieties to the Imperial Valley is impracticable. Experiments have shown that these varieties are

not suited to conditions in the Imperial Valley on account of later maturity, low yield, small percentage, and uneven length of lint. With respect to these cultural characters, the Peeler cotton is inferior to the Egyptian cotton as well as to the short-staple varieties. The defects of the Peeler cotton are not found in the Durango, which is early and productive and has abundant, uniform fiber.

Though the soil and climate of the Imperial Valley are favorable to the production of an excellent quality of Egyptian cotton, the lack of an adequate supply of labor for picking interferes with the development of an Egyptian cotton industry in that community. The introduction of the Durango cotton meets the demand for a long-staple variety adapted to the local conditions and promises the largest profits for the farmers of the valley.

IMPROVED APPARATUS FOR DETECTING SULPHURED GRAIN.[1]

By George H. Baston, *Assistant in Grain Standardization.*

The apparatus [2] commonly in use for detecting sulphured grain consists of an Erlenmeyer flask of 500 c. c. capacity, fitted with a cork stopper and a delivery tube.

The chief objection to this apparatus is that it is almost impossible to make a cork connection perfectly tight, and it is also very hard to keep clean. The escape of the gas around the stopper was the first difficulty that the writer tried to overcome. Rubber stoppers are not practicable for this purpose on account of the sulphur which they contain. A hollow, ground-glass stopper with a glass delivery tube attached was substituted for the cork connections. The hollow in the center of the stopper should be filled with cotton, which acts as a filter, thereby preventing the dirt and dust from being carried over with the gas. The dimensions of the apparatus are shown in figure 1.

The method used for detecting sulphured grain is as follows:

Place 100 grams of the grain to be examined, together with 10 grams of zinc, mossy or granular, chemically pure and free from sulphur, in a 500 c. c. flask. Pour into the flask enough diluted hydrochloric acid (1 part of acid to 4 parts of distilled water, by volume) to just cover the grain. Close the flask with the ground-glass connection and place the end of the glass delivery tube in a test tube containing a 2 per cent solution of lead acetate (2 grams of chemically pure lead acetate in 98 c. c. of distilled water) which has just been filtered. The test tube should be only about three-fourths full of the lead-acetate solution, in order to prevent spilling when the gas begins to pass over. The delivery tube should extend to within about 1 inch of the bottom of the test tube. Figure 1 shows how the apparatus should be adjusted.

In the case of unbleached grain, the gas liberated from the zinc and hydrochloric acid is hydrogen; with grain which has been bleached with sulphur, the gas liberated is hydrogen sulphid, the

[1] Issued Feb. 1, 1913.

[2] The method for the detection of sulphured grain is described in detail in Circular 40, Bureau of Plant Industry, U. S. Department of Agriculture, entitled "A simple method of detecting sulphured barley and oats," by W. P. Carroll, Assistant in Grain Standardization.

presence of sulphur being indicated by a black precipitate of lead sulphid which forms in the test tube.

To avoid any mistake in determining whether or not grain has been bleached it is advisable before making the test to make several experiments with both bleached and unbleached grain and also

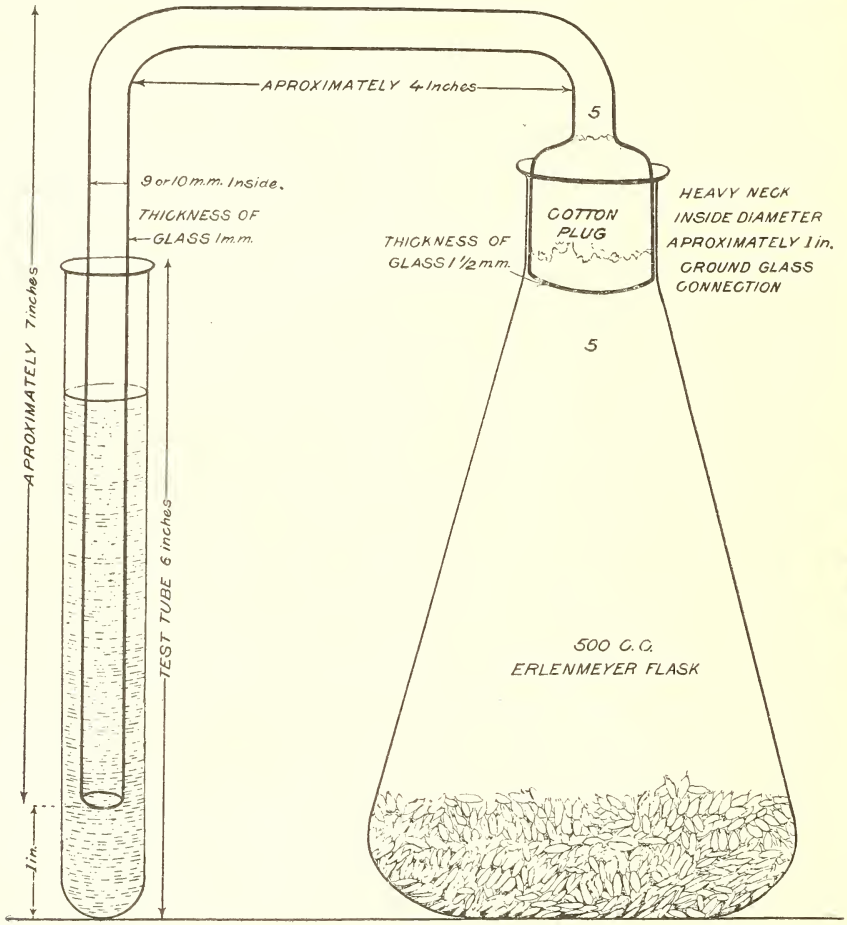

FIG. 1.—Improved apparatus for detecting sulphured grain, showing its dimensions and the manner of adjustment.

with mixtures of the two. For example, samples containing 2 per cent, 5 per cent, 10 per cent, and 50 per cent of bleached grain should be tested, in order to become familiar with the appearance of the precipitate when there is only a small quantity of sulphur present.

SUPERNUMERARY CARPELS IN COTTON BOLLS.[1]

By Rowland M. Meade, *Scientific Assistant, Crop Acclimatization and Adaptation Investigations.*

DISCOVERY OF THE ABNORMALITY.

An examination of a large number of bolls from several varieties of cotton grown at Lanham, Md., in 1908, revealed an interesting abnormality. An early frost had destroyed the leaves, but the stalks and bolls were in the normal green condition. Many bolls had reached maturity, but none had opened naturally, so it was necessary to make all observations in artificially opened bolls.

In its simplest form the abnormality consisted of a solid, elongated, whitish body, developed in the center of the boll between the placentæ. (See fig. 1.)

In many instances, however, this body was divided into from two to five longitudinal compartments, resembling miniature locks, which inclosed rudimentary ovules. In some cases it extended nearly the entire length of the boll, but was always unattached except at the base. Although the abnormalities observed at Lanham were poorly developed, the longitudinal compartments with the inclosed rudimentary ovules warranted the belief that they might be regarded as supernumerary carpels.

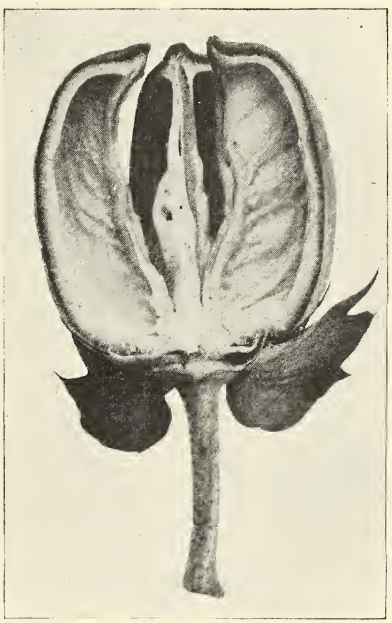

Fig. 1.—Supernumerary carpels between the placentæ of a green cotton boll. From Glendale, Cal. (Natural size.)

In some respects this abnormality resembles that found in the navel orange. There is a difference, however, in that the supernumerary carpels of the cotton boll develop at the base of the placentæ, while in the orange they are produced at the opposite end of the fruit.

[1] Issued Feb. 1, 1913.

At Lanham the abnormality occurred particularly in the bolls of a new type of Upland cotton introduced from the State of Durango, Mexico, but it was also found in the Triumph, a Texas variety. Since 1908 the same abnormality has been observed in other varieties at different points in the United States and has been given more thorough examination.

OCCURRENCE AT GLENDALE, CAL.

During the seasons of 1910 and 1911 more perfect examples of this abnormality were found at Glendale, Cal., both in green and open bolls. Here the resemblance to miniature carpels was very plain. None of the Upland varieties grown at Glendale were exempt from this abnormality, while only one or two cases were found in several rows of different varieties of Egyptian cotton. Although the vegetative parts of the plants showed no excessive growth, the bolls commonly grew to an unusual size. These were frequently abnormal. A large number of bolls had the carpels separated at the apex and in some cases the carpels were distinct to the base, with the exception of the parts along the placentæ.

At Glendale supernumerary carpels sometimes developed in otherwise normal bolls, but they were most frequently associated with the bolls having separated carpels. The true carpels of such bolls were loosely connected, and the inner faces of the placentæ were flattened or hollowed to provide space for the central carpels. Although they completely filled the space between the placentæ, the abnormal carpels were in no way attached to the true carpels or to the placentæ. Supernumerary carpels measuring more than an inch in length by three-eighths of an inch in breadth were frequently noted. Ovules, an eighth of an inch or less in length, producing extremely weak fiber, which in some cases measured half an inch, developed within the compartments of the supernumerary carpels, apparently without fertilization. In open bolls the supernumerary carpels became dry and woody and the compartments split along the back. Through the narrow slits the fiber emerged, and the resemblance to a miniature boll was striking.

RELATION OF CLIMATIC CONDITIONS TO ABNORMALITY.

There appear to be similarities in the climatic conditions of the localities where these supernumerary carpels have been observed to develop most frequently. At Lanham, Md., and Glendale, Cal., the climatic conditions are not favorable for the production of cotton on a commercial scale. At Lanham the growing season is generally too short to mature a crop before frost, and the bolls seldom ripen normally. At Glendale the nights are cool for most of

the season, though the days are hot and dry. As the normal period of growth and development of the plant is at night, it seems not unreasonable to suppose that the low temperatures might induce such abnormalities. This abnormality has also been observed at other points where the growing seasons are limited or the nights cool, such as Kerrville, Tex., and Chico, Cal.

OCCURRENCE AT CLARKSVILLE, TEX.

During the autumn of 1912 many unusually good examples of these supernumerary carpels were observed at Clarksville, Tex., occurring commonly in otherwise normal bolls. They were detected only in the bolls at the base of the plant—those developed earliest in the spring. The spring of that year was rather late and somewhat cooler than usual, and it may be on this account that the abnormalities were produced in such abundance.

FIG. 2.—Well-developed supernumerary carpels inclosing apparently normal seeds. From Clarksville, Tex. (Natural size.)

Nearly all specimens examined were so well developed that they contained rudimentary lint-covered seeds. Specimens consisting of from two to five separated or connected leaf-like members were examined and there was no mistaking their nature. When flattened out they resembled miniature elliptical or slightly lobed leaves with inturned thickened margins. The rudimentary ovules in some cases appeared to be borne on the thickened margins, while in others they seemed to be in a line extending from the sinus between the small lobes and their point of attachment to the peduncle.

An exceptional specimen in which apparently normal seeds had developed in one of these supernumerary carpels was found at Clarksville, Tex., by Mr. C. H. Clark. (See fig. 2.)

The two seeds inclosed in one of these carpels, though somewhat smaller than normal, produced abundant fiber of good length and strength. This specimen was not observed until after the locks had been removed from the normal carpels and the supernumerary carpels had been somewhat mutilated, but the indications from the broken

tip of one of the carpels were that a threadlike projection extended beyond the normal carpels. Fertilization may have taken place through this extended tissue. It remains to be seen whether these seeds are capable of producing plants, but their presence in such a mature form proves most emphatically the real nature of these abnormalities. Mr. Clark's own description of the specimen found at Clarksville follows:

A boll of an Upland variety of cotton found at Clarksville, Tex., in the fall of 1912 had developed between the placentæ two large supernumerary carpels which contained two apparently normal seeds. One of these abnormal carpels was thick and hard, resembling a normal carpel except that it was narrower (8 millimeters) and attached along its back to the placenta of a normal carpel for half the length of the normal boll. From here it projected independently. Although this projection had been broken off before the specimen was found, it must have extended to the apex of the boll and have furnished means of fertilization for the seeds. The other carpel had the appearance of a thin obovate leaf, measuring 1 centimeter in width and about 2 centimeters in length. This was attached only at the base. Three veins could be easily traced in this leaf-like carpel and the surface was dotted with oil glands, but it is doubtful whether placentæ had been developed on the margins. Two locks were contained within the cavity formed by these two abnormal growths. One lock consisted of two apparently normal seeds and three rudimentary ovules. The other consisted of rudimentary ovules only. The two seeds, though a little undersized, produced abundant lint, that of one measuring 33 millimeters and of the other, 25 millimeters in length. The surrounding boll was in other respects normal, with the exception that the five placentæ of the carpels were flat and widened to about 3 millimeters.

OCCURRENCE ON OTHER PLANTS.

At Washington, D. C., on the grounds of the Department of Agriculture, are several plants of althæa (*Hibiscus syriacus*) which in 1911 were abnormal in this same respect. Supernumerary carpels, two to five in number, develop between the placentæ, although the normal series of carpels are not distorted. The central carpels in some cases contain rudimentary ovules.

KEEPING SOFT CUTTINGS ALIVE FOR LONG PERIODS.[1]

By George W. Oliver, *Plant Breeder and Propagator, Office of Foreign Seed and Plant Introduction.*

It has often been found desirable to bring soft or herbaceous plant cuttings from long distances, but the difficulty heretofore attending their transportation has been that the cuttings do not remain in good condition longer than a day or two. This difficulty has been removed by an exceedingly simple contrivance.

Dormant hard-wooded cuttings and scions can be sent long distances by mail, as was demonstrated a few years ago in a collection of scions and bud sticks forwarded to Mr. William S. Lyon, at that time in the service of the Government of the Philippine Islands. Not only did the material reach its destination in good condition, but some of it was repacked according to instructions and returned to Washington, where it was successfully grafted in the greenhouses of the Department of Agriculture.

Soft or herbaceous cuttings, on the other hand, such as those of alfalfa, clover, and many other plants, can not be sent long distances by mail or express, but they will survive a journey of six weeks in perfect condition if kept where they can be given light occasionally and attention is paid to supplying the water lost through evaporation. This treatment in the case of alfalfa and many other plants induces healthy root action during a journey of several weeks' duration.

The apparatus for successfully bringing cuttings of herbaceous plants from distant places is of the simplest nature. The necessary articles are a small quantity of living sphagnum moss, two sheets of strong glass, 5 by 7 inches or larger, and some string. The cuttings should be prepared in much the same way as though intended to be placed in a propagating bed.

Arrange the first layer of cuttings without too much crowding and with the upper surfaces of the leaves on the first piece of glass and on top of the cuttings, and place about 2 or 3 inches of living sphagnum moss evenly distributed over the cuttings. Place another layer of cuttings on top of this moss, with the under surfaces of the leaves next to the moss, so that all the available space will be covered, and

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on top of this second layer of cuttings place the second piece of glass. Press down firmly, remove the moss which protrudes beyond the edges of the glass, and tie together with stout twine (fig. 1).

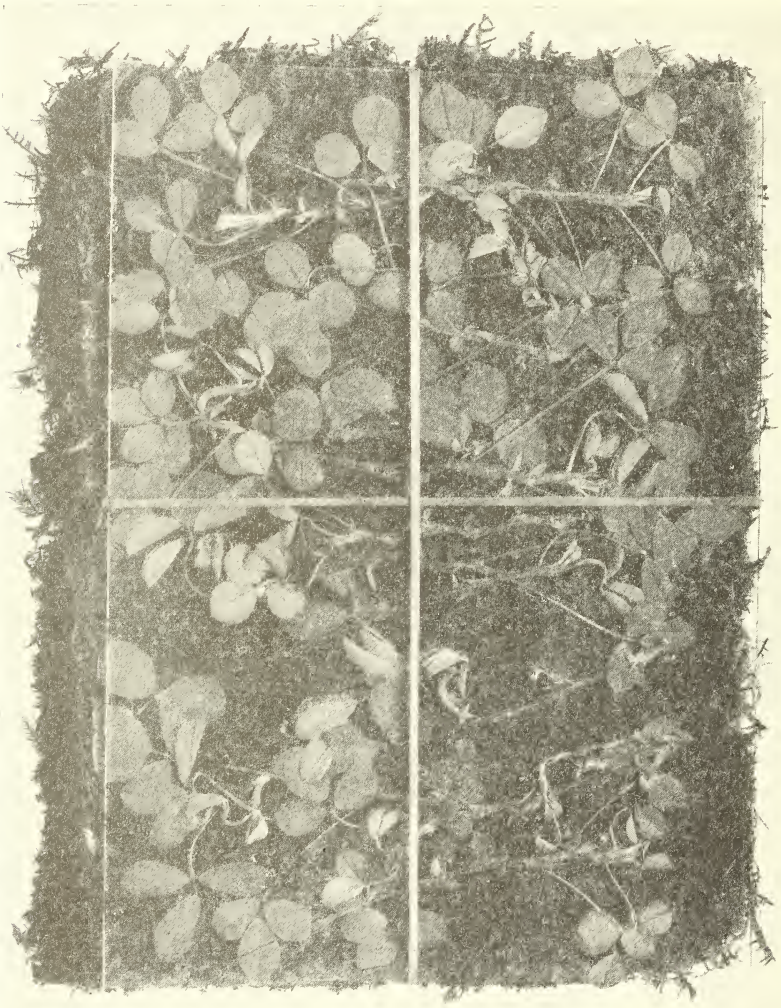

FIG. 1.—Alfalfa cuttings arranged on dampened sphagnum moss and covered with glass.

The package now consists of two pieces of glass, 2 inches of pressed sphagnum moss, and two layers of cuttings—one between each piece of glass and the moss. By keeping the moss moist and giving all the light possible (direct sunlight is best, and it does not raise the temperature of the moss to an appreciable extent beyond that of

the surrounding atmosphere), the cuttings are not in the least injured, provided the material is free from fungous troubles. If the journey is long enough—say, of four to six weeks' duration—cuttings such as those of clover, alfalfa, Dorycnium, lotus, and many other plants will have rooted freely while closely pressed against the glass. During the time of rooting no attention is required beyond keeping the moss wet and exposing the cuttings to the light for a few hours each day.

With the moss only slightly dampened, scions and bud sticks of rare plants keep a very long time in good condition under the same treatment.

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